POST GRADUATE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF JAMMU, JAMMU

M.SC. CHEMISTRY				
S.No.	**Course No.**	**Course Category**	**Title**	**Credits**
Semester-I				
1.	PSCHTC101	PSCC	Theories of Bonding and Inorganic Reaction Mechanism	04
2.	PSCHTC102	PSCC	Quantum Chemistry	04
3.	PSCHTC103	PSCC	Organic Reaction Mechanism-I	04
4.	PSCHTC104	PSCC	Principles of Spectroscopy	04
5.	PSCHLC105	PSCC	Laboratory Course: Inorganic Chemistry	03
6.	PSCHLC106	PSCC	Laboratory Course: Physical Chemistry	03
7.	PSCHLC107	PSCC	Laboratory Course: Organic Chemistry	02
Semester-II				
1.	PSCHTC201	PSCC	Group Theroy and Transition Metal Chemistry	04
2.	PSCHTC202	PSCC	Chemical Dynamics, Surface and Electro Chemistry	04
3.	PSCHTC203	PSCC	Organic Reaction Mechanism-II	04
4.	PSCHTC204	PSCC	Applications of Spectroscopy in Organic Chemistry	04
5.	PSCHLC205	PSCC	Laboratory Course: Inorganic Chemistry	03
6.	PSCHLC206	PSCC	Laboratory Course: Physical Chemistry	02
7.	PSCHLC207	PSCC	Laboratory Course: Organic Chemistry	03
Semester-III				
1.	PSCHTC301	PSCC	Photochemistry and Spectroscopy in Inorganic Chemistry	04
2.	PSCHTC302	PSCC	Thermodynamics and Statistical Mechanics	04
3.	PSCHTC303	PSCC	Bio-organic and Medicinal Chemistry	04
4.	PSCHTO304	PSOCC	Environmental Chemistry	04
5.	PSCHLC305	PSCC	Laboratory Course: Inorganic Chemistry	02
6.	PSCHLC306	PSCC	Laboratory Course: Physical Chemistry	03
7.	PSCHLC307	PSCC	Laboratory Course: Organic Chemistry	03
Semester-IV				
1.	PSCHTE401	PSEC	Analytical Chemistry	04
2.	PSCHTE402	PSEC	Organotransition Metal Chemistry	04
3.	PSCHTE403	PSEC	Bioinorganic and Supramolecular Chemistry	04
4.	PSCHTE404	PSEC	Solid State Chemistry	04
5.	PSCHTE405	PSEC	Polymer Chemistry	04
6.	PSCHTE406	PSEC	Chemistry of Materials	04
7.	PSCHTE407	PSEC	Heterocyclic Chemistry and Asymmetric Synthesis	04
8.	PSCHTE408	PSEC	Organic Synthesis	04
9.	PSCHTE409	PSEC	Chemistry of Natural Products and Molecular Rearrangements	04
10.	PSCHTO410	PSOCC	Instrumentation and Analytical Methods	04
11.	PSCHLE411	PSEC	Laboratory Course: Inorganic Chemistry	08
12.	PSCHLE412	PSEC	Laboratory Course: Physical Chemistry	08
13	PSCHLE413	PSEC	Laboratory Course: Organic Chemistry	08
NOTE: The students of Chemistry Department in IIIrd and IVth semester will register for a minimum of 4 credits of courses from other science departments.				

Pattern of Examination:

Theory

There shall be two **Minor** (**Minor – I** and **Minor – II**) and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20 % and its duration will be of one hour. The Major test shall have marks weightage of 60 % and its duration will be of two and half hours. **Minor – I** will be held after 3 - 4 weeks on completion of 20 % of the prescribed syllabus. **Minor – II** will be held after 8 - 9 weeks on completion of 21 to 40 % of the prescribed syllabus.

The major test will be held at the end of semester on completion of 41 to 100 % of the syllabus. This test will have seven questions, each of fifteen marks. One question will be compulsory and very short answer type of multiple parts spread over entire syllabus. The remaining six questions will be from remaining 41 to 100% part of the syllabus and the candidate will have to attempt any three of them.

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50 %. The final practical performance test along with viva- voce examination will be held at the end of semester covering 100 % of the syllabus and having marks weighage of 50 %.

DETAILED SYLLABUS

Course No.: **PSCHTC101** Course Category: **PSCC**
Title: **Theories of Bonding and Inorganic Reaction Mechanism**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examination to be held in Dec. 2014, Dec. 2015 & Dec. 2016.

Stereochemistry and Bonding in Main Group Compounds
VSEPR model, Bent rule, energetics of hybridization, structure and hybridization, dπ–pπ bonds, structure and bonding in condensed phosphates, silicates, cyclophosphazenes and S–N cyclic compounds.

Metal Ligand Equilibria in Solution
Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

Theories of Bonding
Crystal field theory and its limitations, evidence of metal-ligand orbital overlap, molecular orbital theory, MO energy level diagrams for octahedral, tetrahedral and square planar complexes.

Reaction Mechanism of Transition Metal Complexes-I
Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, Kinetic applications of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.

Reaction Mechanism of Transition Metal Complexes-II
Substitution reactions in square planar complexes, the Trans effect, mechanism of the substitution reaction, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere reactions, cross reactions and Marcus and Hush theory, inner sphere reactions.

BOOKS RECOMMENDED

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Magneto Chemistry, R.L. Carlin, Springer Verlag.
5. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.

DETAILED SYLLABUS

Course No.: **PSCHTC102** Course Category: **PSCC**
Title: **Quantum Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2014, Dec. 2015 & Dec. 2016.

Exact quantum mechanical results

Schrodinger equation and the postulates of quantum mechanics. Operator concept, some properties of quantum mechanical operators. Linear and Hermitian operators. Schrodinger wave equation for Hydrogen atom, separation into three equations, quantum numbers and their importance. Radial and angular wave functions (Spherical harmonics).

Complete solution of Schrodinger equation for the following model systems: Particle in a box (1 and 3 dimensional).Concept of degeneracy. The solution of problems of harmonic oscillator & the rigid rotator.Calculation of various average values for the above systems.

Angular momentum and electronic structure of atom

General theory of angular momentum. Eigen functions and Eigen values of angular momentum operators. Ladder operators. Spin angular momentum, antisymmetry and Pauli's principle.

Electronic configuration, Russell-Saunders terms and coupling schemes, Slater determinant. Atomic term symbols, term separation of p^n configurations, spin-orbit coupling, Zeeman splitting, virial theorem.

Approximation methods

The Variation theorem, linear variation principle. Perturbation theory -first order (non-degenerate). Application of variation method and perturbation method to helium atom.

Chemical Bonding

Molecular orbital theory, LCAO-MO approximation, H_2^+molecular ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave function, brief introduction to H_2. Valence bond treatment of H_2, comparison of MO and VB methods.

HMO method and its applications

Huckel's MO theory of conjugated systems; Application to ethylene, butadiene, cyclobutadiene. Calculation of properties- Delocalization energy, electron density and bond order.

BOOKS RECOMMENDED

1. Physical Chemistry, P. W. Atkins, ELBS Oxford, 1997.
2. Introduction to Quantum Chemistry, A. K. Chandra, TataMcGraw Hill, 1997.
3. Quantum Chemistry, Ira. N. Levine, Prentice Hall, 2000.
4. Molecular Quantum Mechanics, P. W. Atkins and R. S. Friedmann, Oxford, 1997.
5. Quantum Chemistry, Prasad, New Age Publishers, 2000.
6. Quantum Chemistry and Spectroscopy (Problems and solution), Madan S. Pathania.

DETAILED SYLLABUS

Course No.: **PSCHTC103** Course Category: **PSCC**
Title: **Organic Reaction Mechanism- I**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2014, Dec. 2015 & Dec. 2016.

Nature of bonding in organic molecules

Delocalized chemical bonding-conjugation, cross-conjugation, resonance, hyperconjugation, tautomerism.

Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, crown ether complexes and cryptands, inclusion compounds, cyclodextrins.

Stereochemistry

Conformational analysis of cyclohexanes, decalins, effect of conformation on reactivity, steric strain due to unavoidable crowding.

Elements of symmetry, chirality, R&S configuration, molecules with more than one chiral center, threo- and erythro- isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes). Stereochemistry of the compounds containing nitrogen and sulfur.

Reaction Mechanism: Structure and Reactivity

Types of mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Structure, stability and reactivity of carbenes and nitrenes. Effect of structure on reactivity – resonance and field effects, steric effect, qualitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants.

Aliphatic Nucleophilic Substitutions - I

The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by σ and π bonds. Classical and non-classical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements (Pinacol-Pinacolone, Wagner-Meerwin).

The S_Ni mechanism.

Aliphatic Nucleophilic Substitutions-II

Nucleophilic substitutions at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium; phase transfer catalysis and ultrasound, ambident nucleophile and regioselectivity.

Aliphatic Electrophilic Substitution

Bimolecular mechanism: S_E2 and S_E1. Electrophilic substitutions accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

BOOKS RECOMMENDED

1. Advanced Organic Chemistry, Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advance Organic Chemistry, F.A. Carey & R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Corell University Press.
5. Organic Chemistry, R.T. Morrison & R.N. Boyd, Prentice Hall.
6. Stereochemistry of Organic Compounds, D. Nasipuri.
7. Organic Synthesis, Michael B. Smith, McGraw Hill.

DETAILED SYLLABUS

Course No.: **PSCHTC104** Course Category: **PSCC**
Title: **Principles of Spectroscopy**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2014, Dec. 2015 & Dec. 2016.

Unifying Principles
Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarisation and scaterring, Uncertainty relation and natural line width and natural line broadening, transition probability, intensity of spectral lines, Beer-Lambert's law, results of the time dependent perturbation theory, transition dipole moment, selection rules, induced quantum transitions, interaction of electromagnetic radiation with a molecular system, induced emission and induced absorption, Einstein's coefficient, LASERS.

Introduction of molecular spectroscopy
Rotational spectroscopy of diatomic molecules based on rigid approximation. Determination of bond length and/or atomic masses from microwave data. Effect of isotopic substitution. Non-rigid rotator. Classification of polyatomic molecules. Energy levels and spectra of symmetric top molecules and asymmetric top molecules. First order Stark effect.

Vibrational Spectroscopy
Normal coordinate analysis of homonuclear and heteronuclear diatomic molecules. Extension to polyatomic linear molecules. Derivation of selection rules for diatomic molecules based on Harmonic oscillator approximation. Force constants and amplitudes. Anharmonic oscillator. Overtones and combination bands.
Dissociation energies from vibrational data. Vibration-rotation spectra, P, Q and R branches. Breakdown of the Born-Oppenheimer approximation. Nuclear spin effect.

Raman Spectroscopy
Stokes and anti-stokes lines. Polarizability ellipsoids. Rotational and Vibrational Raman spectroscopy. Selection rules. Polarization of Raman lines.

X-ray Diffraction
Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identifications of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis.

Electron diffraction
Scattering intensity and scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, electron diffraction studies of some compounds, low energy electron diffraction (LEED) and structure of surfaces, applications of LEED.

Neutron Diffraction
Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

BOOKS RECOMMENDED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.l.Ho. Wiley Interscience.
3. NMR, NQR, EPR and Mossabauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
9. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance, A Carrington and A.D. Maclachalan, Harper & Row.

DETAILED SYLLABUS

Course No.: **PSCHLC105** Course Category: **PSCC**
Title: **Laboratory Course: Inorganic Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**
Syllabus for the examinations to be held in Dec. 2014, Dec. 2015 & Dec. 2016.

Inorganic Chemistry

1. **Qualitative analysis of less common (rare) metals**
   Analysis of mixture containing less common metal ions : Tl, W, Mo, Se, Te, Zr, Ti, Ce, Th, V, U, Li (four metal ions in cationic/anionic forms)
2. **Separation and quantitative estimation of two metal ions**
   Cu-Ni: Estimation of both by gravimetric method
   Ba-Cu: Estimation of Ba gravimetrically and Cu volumetrically
   Ag-Cu, Estimation of Ag gravimetrically and Cu volumetrically
   Cu-Zn: Estimation of both by gravimetric method
   Ni-Zn: Estimation of both by gravimetric method
   Cu-Fe: Estimation of both by gravimetric method
   Ca-Mg: Estimation of both by titrating against EDTA solution
   Zn-Mg: Estimation of both by titrating against EDTA solution
3. To determine the total hardness of water (due to presence of Ca^{2+} and Mg^{2+} salts)

BOOKS RECOMMENDED

1. Vogal's Qualitative Inorganic Analysis, 7^{th} Edn. Pearson Education Ltd.
2. Vogal's Textbook of Quantitative Inorganic Analysis, 4^{th} Edn., Longman Group Limited, London.

DETAILED SYLLABUS

Course No.: **PSCHLC106** Course Category: **PSCC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in Dec. 2014, Dec. 2015 & Dec. 2016.

Physical Chemistry

Number of hours for each experiment: 3-4 hours
A list of experiments under different headings is given below. Typical experiments are to be selected from each type. Students are required to perform at least 30 experiments.

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors, error distribution curves, precision, accuracy and combination; statistical treatment for error analysis, student 't' test, null hypothesis, rejection criteria, F&Q test; linear regression analysis, curve fitting, calibration of volumetric apparatus, burette, pipette and standard flask.

Phase Equilibria

To construct the phase diagram for three component system (e.g. Chloroform-acetic acid-water, ethanol-benzene-water, ethanol-ethylacetate-water, acetic acid-benzene-water).

Chemical Kinetics

i) Determination of the effect of (a) change of temperature (b) change of concentration of reactants and catalyst and (c) ionic strength of media on the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
ii) Determination of velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
iii) Determination of the rate constant for the oxidation of iodine ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.
iv) Flowing clock reactions.
v) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsonted relationship (iodide ion is oxidized by persulaphate ion).

Solutions

i) Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
ii) Determination of the degree of disassociation of weak electrolyte and to study the deviation from ideal behavior that occurs with a strong electrolyte.

Viscosity

i) Determination of molecular weight of high polymer(polystyrene) from viscosity measurements.

Surface-Tension

Study of variation of surface tension of solution with concentration and determination of surface excess. Study of interfacial tension between two immiscible liquids CMC from surface-tension measurements.

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.

3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **PSCHLC107** Course Category: **PSCC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **02** Maximum Marks: **50**
No.of hours**: 30**

Syllabus for the examinations to be held in Dec 2014, Dec 2015 & Dec 2016.

Organic Chemistry

Quantitative Analysis

Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using TLC and column chromatography, chemical tests, IR spectra to be used for functional group identification.

Organic Synthesis

Acetylation: Acetylation of Cholesterol and separation of cholesteryl acetate by column chromatography.

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Grignard reaction: synthesis of triphenylmethanol from benzoic acid.

Aldol condensation: Dibenzal acetone and benzylidene acetone from benzaldehyde .

BOOKS RECOMMENDED

1. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middlenton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

DETAILED SYLLABUS

Course No.: **PSCHTC201** Course Category: **PSCC**
Title: **Group Theory and Transition Metal Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Symmetry and Group theory in Chemistry
Symmetry elements and symmetry operations, definition of group, subgroup. Point symmetry group, Schonfilies symbols, Conjugacy relation and classes, representations of symmetry operations by matrices. Character of a representation. The great orthogonality theorem (without proof). Derivation of character tables for C_{2v}, C_{3v} and C_{2h}. Use of character tables in spectroscopy, symmetry aspects of molecular vibrations of H_2O molecule.

Electronic spectra of transition metal complexes
Spectroscopic ground states, correlation diagrams, selection rules and their breakdown, Orgel diagrams, Tanbe-Sugano diagrams and spectra of transition metal complexes (d^1 to d^9 states), significances of Dq, B and β parameters, Jahn-Teller effect, Nephelauxetic effect, charge transfer spectra.

Magnetic properties of transition metal complexes
Magnetic susceptibility, magnetic moments, Quenching of magnetic moments, spin-orbit coupling, anomalous magnetic behaviour of metal complexes, magnetic exchange and spin-state crossovers.

Metal π-complexes – I
Metal carbonyls, preparation and important reactions of metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation.

Metal π-complexes – II
Prepartation, bonding, structure and important reactions of transition metal, nitrosyls, dinitrogen and dioxygen complexes, ligating behavior of tertiary phosphines.
Isopoly and heteropoly acids and salts of molybdenum and tungsten.

BOOKS RECOMMENDED

1. Symmetry and Spectroscopy of molecules, K.V. Reddy, New Age International Publishers.
2. Group Theory and Symmetry in Chemistry, Kamlesh Bansal, Campus Book International.
3. Symmetry and Structure, S.F.A. Kettle, Wiley.
4. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
5. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
6. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
7. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
8. Magnetochemistry, R.L. Carlin, Springer Verlag.
9. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.

DETAILED SYLLABUS

Course No.: **PSCHTC202** Course Category: **PSCC**
Title: **Chemical Dynamics, Surface and Electro Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Chemical Dynamics – I

Methods of determining rate law, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Pyrolysis of acetaldehyde, decomposition of ethane, photochemical and thermal reaction between hydrogen and bromine, thermal reaction between hydrogen and chlorine, oscillatory reactions (Belousov-Zhabotinsky reaction). Homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method and flash photolysis.

Chemical Dynamics – II

Dynamics of molecular motions, dynamics of unimolecular reactions (Lindemann, Hinshelwood, Rice-Ramsperger-Kassel (RRK) and Rice-Ramsperger-Kassel-Marcus(RRKM) theories of unimolecular reactions).

Macromolecules

Polymer-definition, types of polymers, electrically conducting polymers, kinetics of polymerization, mechanism of polymerization.
Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, sedimentation and light scattering methods), chain configuration of macromolecules, calculation of average dimensions of various chain structures.

Surface Chemistry

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, BET equation, estimation of surface area, surface films on liquids, Catalytic activity at surfaces.

Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding of micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

Electrochemistry-I

Debye-Huckel limiting law, Debye-Huckel-Onsagar treatment and its extension. Debye-Huckel-Jerum mode, Thermodynamics of electrified interfaces. Lippman equation, Method of determination of surface excess, Structure of electrified interfaces: Helmholtz-Perrin, Guoy-Chapman, Stern models.
Over potential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Electrochemistry-II

Semiconductor interfaces-theory of double layer at semi-conductor electrolyte solution interfaces. Electrocatalysis.

Bioelectrochemistry, threshold membrane phenomena, Nernst-planck equation, electrocardiography. Polarography theory, Ilkovic equation; half wave potential and its significance.

Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

BOOKS RECOMMENDED

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Mcgraw-Hill.
3. Kinetics and mechanism of Chemical Transformations, J.Rajaraman and J. Kuiacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
5. Modern Electrochemistry Vol. 1, Vol. 2A and Vol. 2B, J.O.M. Bockris and A.K.N.Reddy, Plenum.
6. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

DETAILED SYLLABUS

Course No.: **PSCHTC203** Course Category: **PSCC**
Title: **Organic Reaction Mechanism- II**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Aromatic Electrophilic & Nucleophilic Substitutions
The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation of other ring systems. Friedel-Crafts reaction of alkenes and alcohol substrates, Vilsmier reaction. Gattermann-Koch reaction.

Aromatic Nucleophilic Substitutions
The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity effect of substrate structure, leaving group and attacking nucleophiles. The Von Richter, Sommelet-Hauser, and Smiles rearrangements.

Addition of Carbon-Carbon Multiple Bonds & Elimination Reactions
Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity, addition to cyclopropane ring, hydroboration, Michael reaction, Sharpless asymmetric epoxidation.

Elimination Reactions
The E2, E1 and E1cB mechanisms. Orientation of the double bond. Reactivity: effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic eliminations.

Addition to Carbon-Hetero Multiple Bonds
Mechanisms of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.
Mechanism of condensation reactions involving enolates – Aldol, Knoevenagel and Claisen. Hydrolysis of esters and amides.

Pericyclic Reactions
Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, and 1,3,5-hexatriene system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n and 4n+2 systems. Cycloadditions: antrafacial and suprafacial additions, 4n and 4n+2 systems, 1,3-dipolar cycloadditions.
Sigmatropic rearrangements-suprafacial and antrafacial shifts of H, Sigmatropic shifts involving carbon moieties, Claisen, Cope and Ene reaction.

Free Radical Reactions
Types of free radical mechanisms (substitution at an aromatic substrate), neighbouring group assistance: reactivity (at an aliphatic, aromatic substitute and at bridge head). The effect of solvent and attacking radicals on reactivity. Allylic halogenations (NBS), oxidation of

aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction and Hunsdiecker reaction.

BOOKS RECOMMENDED

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerrry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentic-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Acadmeic and Professional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.

DETAILED SYLLABUS

Course No.: **PSCHTC204** Course Category: **PSCC**
Title: **Applications of Spectroscopy in Organic Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Ultraviolet and Visible Spectroscopy
Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.

Optical Rotatory Dispersion (ORD) and Circular Dichorism (CD)
Definition, deduction of absolute configuration, octant rule for ketones.

Infrared Spectroscopy
Basic principles, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

Nuclear Magnetic Resonance Spectroscopy
General introduction and definition, larmour frequency, chemical shift, spin-spin interaction, shielding mechanism, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry: hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra: nuclear magnetic double resonance, contact shift reagents, solvent effects, Fourier transform techniques, nuclear Overhauser effect (NOE). Resonance of other nuclei –F, P.

Carbon-13 NMR Spectroscopy
General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon). Two dimensional NMR spectroscopy – COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

Mass Spectrometry
Introduction, ion production – El, Cl, FD and FAB, factors affecting fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their determination. Introduction to modern MS techniques (MALDI, ESI).

BOOKS RECOMMENDED

1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry, Vol. 8 ed., F.A. Cotton, Vol. 15 ed., S.J. Lippard, Wiley.
5. Transition Metal Chemistry, ed. R.L. Carlin, Vol. 3, Dekker.
6. Inorganic electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw Hill.
13. Organic Spectroscopy, William Kemp.

DETAILED SYLLABUS

Course No.: **PSCHLC205** Course Category: **PSCC**
Title: **Laboratory Course: Inorganic Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**
Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Inorganic Chemistry

Preparations

a) Preparation of selected inorganic compounds.

1. $Hg[Co(NCS)_4]$
2. $[Cu(NH_3)_4]\ SO_4\ H_2O$
3. cis-$K[Cr(C_2O_4)_2(H_2O)_2].2H_2O$
4. trans- $K[Cr(C_2O_4)_2(H_2O)_2]\ .2H_2O$
5. $VO(acac)_2$
6. $K_3[Cr(C_2O_4)_3].\ 3H_2O$
7. $K_3[Fe(C_2O_4)_3].\ 3H_2O$
8. $Mn(acac)_3$
9. $[Co(en)_2(C_2O_4)]Cl.\ H_2O$
10. $[Co(NH_3)_5(NO_2)](NO_2)_2$
11. trans- $[Co(en)_2Cl_2]Cl$
12. $[Ni(en)_3]Cl_2$ & trans-$[Ni(en)_2Cl_2]$
13. $TiO(C_9H_8NO)_2H_2O$
14. $Na[Cr(NH_3)(NCS)_4]$
15. $Ni(acac)_2$
16. $[Co(Py)_2Cl_2]$
17. $[Ni(NH_3)_6]Cl_2$
18. $Ni(dmg)_2$
19. $[Co(NH_3)_6]\ [Co(NO_2)_6]$
20. cis- $[Co(trien)(NO_2)_2]Cl.H_2O$
21. Pressian Blue, Turnbull's Blue

b) Quantitative analysis of metals in complexes by Gravimetric/Volumetric techniques.

c) Structural investigation by I.R., electronic spectra and magnetic susceptibility measurements.

BOOKS RECOMMENDED

1. Synthesis and Characterization of Inorganic Compounds, William L. Jolly, Prentice Hall.
2. Vogal's Textbook of Quantitative Inorganic Analysis, 4th Edn., Longman Group Limited, London.

DETAILED SYLLABUS

Course No.: **PSCHLC206** Course Category: **PSCC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **02** Maximum Marks: **50**
No.of hours**: 30**
Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Heat of solution:
To study the heat of solution of benzoic acid/oxalic acid by solubility method at different temperatures and the effect of electrolyte on it.

Adsorption:
Study the adsorption of oxalic acid on charcoal and hence check the validity of Langmuir adsorption isotherm and classical adsorption isotherm.

Critical solution temperature:
Determine the mutual solubility curve of phenol and water and hence find its consolute temperature and the effect of electrolyte on the system.

Abbe's refractometer:
Determine the refractive indices of given organic liquid at room temperature

pH meter and Conductivity meter:
Determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of acid.
Determine the strength of strong and weak acid and their mixture using pH metry.
Determine the strength of strong and weak acid and their mixture using conductivity meter.
Study of kinetics of second order reaction using conductivity –meter .

Phase-Equilibria

Phase diagram of two component eutectic systems (Naphthalene-benzoic acid; acetamide-benzoic acid; naphthalene-diphenyl).

Phase diagram of two component compound forming systems (salicylic acid – benzamide, acetamide-β-naphthol).

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **PSCHLC207** Course Category: **PSCC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in May 2015, May 2016 & May 2017.

Organic Chemistry

a. **Organic Synthesis:** Sandmeyer reaction: p-Chlorotoluene from p-toluidine. Acetoacetic ester condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. Cannizzaro reaction: Benzaldehyde and 4-chlorobenzaldehyde as substrates. Knoevenagel Condensation: Synthesis of cinnamic acid. Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene. Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. Beckmann rearrangement of acetophenone and benzophenone oximes.
The products may be characterized by spectral techniques.

b. Separation and identification of organic compounds from two component mixture.

c. **Quantitative Analysis:** Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method. Estimation of amines/phenols and glucose using bromated bromide solution/acetylation method. Determination of iodine and saponification values of an oil sample. Determination of DO, COD and BOD of water sample.

BOOKS RECOMMENDED

1. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middlenton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

DETAILED SYLLABUS

Course No.:**PSCHTC301** Course Category: **PSCC**
Title: **Photochemistry and Spectroscopy in Inorganic Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2015, Dec. 2016 & Dec. 2017.

Ligand Field Photochemistry

Types of excited states of coordination compounds: Ligand field, intra-ligand and Charge-transfer excited states,

Ligand field photochemistry of Cr(III) complexes, photolysis rules, photochemistry of mixed ligand Cr(III) complexes, stereochemistry, role of doublet and quartet excited states, experimental evidences.

Photosubstitution and photoredox reaction of Co(III) complexes, photosubtitution reactions of Rh(III) complexes.

Photoelectrochemistry

Introduction, Equilibium state at a semiconductor/liquid junction, Qualitative description of interfacial charge equilibration; depletion, depletion width, Quantitative description of interfacial charge equilibration; electric field and electric potential, Charge transfer at a semiconductor/liquid junction, Current-voltage characteristics of semiconductor electrode, energy conversion properties, Strategies for design of semiconductor-liquid junctions for energy conversion.

Vibrational Spectroscopy

Symmetry and shape of AB_2, AB_3, AB_4, AB_5 and AB_6 molecules. Mode of bonding of ambidentate ligands, nitro, thiocyanato, ethylenediamine and diketonato complexes,

Raman Spectroscopy: Stokes and anti-stokes lines, polarisability of ellipsoids, Rotational and vibrational Raman spectroscopy, Selection rules, Resonance Raman spectroscopy, Basic understanding and its applications particularly for study of active sites of metalloproteins.

Electron Spin Resonance Spectroscopy

Basic Principle, spin Hamiltonian, Hyperfine coupling, spin polarization and McConnell relationship, Isotropic and anisotropic hyperfine coupling constants, spin-orbit coupling and significance of g- tensor, Applicaion to transition metal complexes(having one unpaired electron) including biological systems and inorganic free radical viz. BF_2, F_2 , PH_4 etc.

Mossbauer Spectroscopy

Basic Principles, spectral parameters and spectrum display, Application of the technique to the studies of :

(a) bonding and structure of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin,
(b) Sn^{2+} and Sn^{4+} compounds, nature of M-L bond, coordination number, and structure and
(c) Detection of oxidation state and inequivalent MB atoms.

Nuclear Magnetic Resonance of Paramagnetic Substances in Solution

The chemical shift in Diamagnetic and Paramagnetic molecules, The contact and Pseudo-contact shifts, factors affecting nuclear relaxation,

BOOKS RECOMMENDED

1. Principles and Applications of Semiconductor Photoelectrochemistry, Progress in Inorganic
   Chemistry, Volume 41, Kenneth D. Karlin
2. Concepts of Inorganic Photochemistry, A. W. Adamson and P. D. Fleischauer, Wiley.
3. Physical Methods for Chemistry, R. S. Drago, Saunders Company.
4. Infrared and Raman Spectra : Inorganic and coordination compounds, K. Nakamoto, Wiley.
5. Structural Methods in Inorganic Chemistry, E.A. V. Ebsworth, D. W. H. Rankin and S. Cradock, ELBS.
6. Progress in Inorganic Chemistry, Vol. 8, ed., F. A. Cotton, Vol. 15, ed. S.J. Lippard, Wiley.
7. Applications of physical methods to Inorganic and Bioinorganic Chemistry, Robert A. Scott, Charles M. Lukehart, Wiley.

DETAILED SYLLABUS

Course No.: **PSCHTC302** Course Category: **PSCC**
Title: **Thermodynamics and Statistical Mechanics**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2015, Dec. 2016 & Dec. 2017.

Non Equilibrium Thermodynamics

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g. heat flow, chemical reaction etc.) transformation of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electrokinetics phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

Transport Phenomenon

Diffusion coeffieicnt, Fick's first and second laws, relation between flux and viscosity, relation between flux and viscosity, relationship between diffusion coefficient and mean free path, relation between thermal conductivity/viscosity and mean free path of a perfect gas, Einstein relation, Nernst-Einstein equation, Stokes-Einstein equation, Einstein-Smoluchowski equation.

Thermodynamics of Mixtures

Brief resume of classical concepts of thermodynamics inluding free energy, chemical potential and entropies, partial molar properties: partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concepts of fugacity and determination of fugacity.

Non ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions: determination of activity and activity coefficients: ionic strength.

Statistical Mechanics

Role of statistical mechanics, Ensemble: Micro canonical, canonical and grand canonical, postulates of ensemble averaging, phase space, Stirling's approximation, occupation number, micro and macro states, statistical weight factor, probability, concept of distribution, thermodynamic probability, types of statistics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, most probable distribution of three types of statistics, Lagrange's undetermined multipliers, evaluation of β, comparison of three statistics, molecular partition function and its significance, thermodynamic properties in terms of partition function, numericals

Applications of statistical mechanics

Factorisation of molecular partition function, canonical ensemble partition function (Independent and distinguishable molecules or particles; independent and indistinguishable molecules or particles), evaluation of translational, rotational, vibrational, electronic and nuclear partition functions, contribution of translational, rotational and vibrational partition

functions to thermodynamic functions, effect of nuclear spin on diatomic molecules, equilibrium constant of ideal gas in terms of partition function. Heat capacities of solids: the Einstein theory and the Debye theory, molecular basis of residual entropy, numerical.

BOOKS RECOMMENDED

1. Theoretical Chemistry: S. Glasstone.
2. Statistical Thermodynamics: M.C. Gupta.
3. Physical Chemistry: P.W. Atkins.
4. Chemical Thermodynamics: R.P. Rastogi and R.R. Misra.
5. Statistical Mechanics and Properties of Matter: E.S.R. Gopal.
6. Statistical Mechanics, D.A. McQuarrie.
7. Thermodynamics of Irreversible Processes, Rolf Haase.
8. Fundamental of Chemical Thermodynamics, E.N. Yeremin.
9. Introduction to Irreversible Thermodynamics, Prgogine.
10. Modern Thermodynamics, D. KondePudi and I. Prigogine.

DETAILED SYLLABUS

Course No.: **PSCHTC303** Course Category: **PSCC**
Title: **Bio-Organic and Medicinal Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2015, Dec. 2016 & Dec. 2017.

Enzymes, kinds and mechanism of enzymatic reactions
Introduction and historical perspectives, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specialization and regulation. Nomenclature and classification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis.
Orientation and steric effects in enzyme catalysis (acid, base and covalent catalysis).

Chemistry of Vitamin B-Complex and Coenzymes
Introduction, classification and nomenclature of vitamins. Occurance, functions and mechanism of action of thiamine, Riboflavin and Pantothenic acid. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate. NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B_{12}.

Drug-design
Introduction, concept of Lead compounds, Factors governing drug design and rational approach. Drug design through method of variations, disjunction and conjunction. Bioisosteric replacement, rigid analogs, homologation of alkyl chains, changes in ring size and ring position isomers, alteration of stereochemistry, fragments of lead molecules.

Synthesis and mode of action
Cardiovascular drugs: Antihypertensive and hypotensive drugs:
Hydralazine (Apresoline hydrochloride), Methyldopa (Aldomet), Procainamide (Pronestyl); Antisympathetic drugs- Propanolol (Indral), Verapamil (Isoptin) and Prenylaminelactate (Synadrin).
Antiparkinsonian Agents: Biperiden hydrochloride (Akineton hydrochloride), Ethopropazine hydrochloride (Profenamine) and Levodopa (Bendopa).
Anticancer drugs: Adriamycin, Texol, Tamoxifen.
Antihistaminic drugs: Citrizine, (Promethazine hydrochloride) and Chloropheniramine meleate (Alermine).
Antimalarials: Chloroquine phosphate (Resochin) and Mepacrine hydrochloride (Quinacrine).

Antibiotics: Introduction, classification, isolation and chemistry of Pencillins, Chloramphenicol and tetracyclines (oxy tetracycline).
Vitamins: Occurrence, chemistry, functions and mechanism of action of Ascorbic acid, α-Tocopherol and Vitamin K_1 & K_2.

BOOKS RECOMMENDED

1. Bio-organic Chemistry: A Chemical Approach to enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
2. Enzyme Chemistry: Impact and Aplications, Ed. Collin J. Suckling, Chapman and Hall.
3. Enzymatic Reaction Mechanism, C. Walsh and W.H. Greeman.
4. Immobilised Enzymes: An Introduction and Application in Biotechnology, M.D. Travan, John Wiley.
5. Enzyme Structure and Mechanism, A. Fersht and W.H. Freeman.
6. Textbook of Organic Medicinal and Pharmaceuticals Chemistry, 8^{th} Ed., Edited by R.F. Doerge, J.B. Lippincott Co., Philadelphia 1982.
7. Pharmaceutical Chemistry in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley and Sons., N.Y.
8. Principles of Medicinal Chemistry, Lea and Febiger, Philadelphia, USA.
9. Strategies of Organic Drug Synthesis and design, D. Lendnicer, John Wiley and Sons, N.Y.
10. Burger's Medicinal Chemistry, Drug Discovery and Development, John Wiley and Sons.

DETAILED SYLLABUS

Course No: PSCHTO304 **Course Category:PSOCC**
Title: Environmental Chemistry
Credits: 4 **Maximum Marks: 100**
No.of hours**: 60**
Syllabus for the examinations to be held in Dec. 2015, Dec. 2016 & Dec. 2017.

Environment:

Earth's Atmosphere: Structure and composition of atmosphere. Temperature measurements and controls: Vertical temperature and stability of atmosphere. Biogeochemical cycle of Carbon, Nitrogen, Oxygen and Sulfur,

Soils:

Composition of soil and its profile, various micro and macro nutrients present in soil, Nitrogen, Phosphorus and Potassium in soil, Acid-base and ion exchange reactions in soils, Soil pollution due to fertilizers, pesticides and solid waste (plastics and metals).

Hydrosphere

Chemical composition of water bodies – lakes, streams and rivers; Hydrological cycle; Types, sources and classification of water pollutants, industrial water pollution, pollution due to inorganic, organic pesticide, detergent and oil pollutants, constituents of aquatic environment, Effects of water pollutants on life and environment; Water quality parameter and their analytical methods: Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demands, Solids, contents of chloride and chlorine demand.

Industrial Pollution

Environmental implications and abetment of Cement industry, sugar mill, paper and pulp mill, thermal power plant and polymer/plastic industry. Solid Waste Management: landfill, incineration, resource reduction, recycling and reuse, composting and organic farming.

Atmosphere

Atmospheric chemistry: chemical composition of atmosphere – particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effects and analytical methods, Air pollution – types and sources;, depletion of stratospheric ozone, industrial and transport-related air pollution; Global warming and its effects, chlorofluoro hydrocarbons, green house effect and acid rains.

Environmental Toxicology

Hazardous waste: Introduction, origin, transport, effects and fates; Chemical solutions to environmental problems biodegradability, principles of decomposition better industrial processes.

Bhopal gas tragedy, MIC and its impacts and Minamata disasters; Nuclear Hazards: Chernobyl and Three Mile Island

Books Recommended

1. Environmental Chemistry, S. E. Manahan, Lewis Publishers
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers
3. Environmental Chemistry, A. K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S. M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F. J. Welcher, Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.

7. Elemental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
8. Environmental Chemistry, C. Baird and W. H. Freeman.

DETAILED SYLLABUS

Course No.: **PSCHLC305** Course Category: **PSCC**
Title: **Laboratory Course: Inrganic Chemistry**
Credits: **02** Maximum Marks: **50**
No.of hours**: 30**

Syllabus for the examinations to be held in Dec 2015, Dec 2016 & Dec 2017

Preparation of selective inorganic compounds and their study by IR, electronic spectra, and magnetic susceptibility measurement. Handling of air and moisture sensitive compounds involving vacuum lines.

Selection can be made from the following:

1. Sodium amide, Inorg. Synth., 2, 128 (1946).
2. Trialkoxyboranes- Preparation, IR and NMR spectra. J. Am. Chem. Society, Vol 92, 1970.
3. Preparation of vanadylacetyacetonate; Inorg. Synth. 5, 113 (1957).
4. Preparation of tris(ethylenediamine)nickel(II)chloride; Inorg. Synth. 6, 200 (1960)
5. Preparation of tris(acetylacetonato)manganese(III); Inorg. Synth. 7, 183, (1963).
6. Preparation of tris(acetylacetonato)alumimium(III), Inorg. Synth. 7, 183, (1963).
7. Preparation of Trioxalato salts $M'_3[M'''(C_2O_4)_3].3H_2O$ (M' = K and M''' = Al, Fe, Co or Cr); Inorg. Synth. 1, 35, (1939).
8. Dichlorophenylborane-synthesis in vacuum line.

Gravimatric and Volumetric analysis: Vanadium, Nickel, Manganese, Aluminium, Chromium, Chloride (Volhard's method) etc.

Books Recommended:

1. Vogel's textbook of quantitative chemical analysis (5^{th} and 6^{th} edition).
2. G. R. Chatwal, Instrumental Methods for Chemical Analysis, 5^{th} ed., Himalaya Publications (India).

DETAILED SYLLABUS

Course No.: **PSCHLC306** Course Category: **PSCC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in Dec 2015, Dec 2016 & Dec 2017.

Number of hours of each experiment 3-4 hours. A list of experiments under different heading are given below .Typical experiments are to be selected from each type.

Chemical Kinetics

i) Study the kinetics of bromination of phenol by bromide-bromate mixture in an acid medium as a clock reaction.

ii) To find out the order of reaction between potassium bromate and potassium iodide.

Thermodynamics

i) Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.

ii) Determination of temperature dependence of solubility of compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

Conductivity

i) Determine the hydrolysis constant of aniline hydrochloride at different temperatures conductometrically.

ii) Estimate the concentration of HCl, CH_3COOH and $CuSO_4.5H_2O$ in a given solution by carring out conductometric titration with NaOH solution.

iii) Determine the equivalent conductance of a strong electrolyte i.e. NaCl, KCl at several concentrations and hence verify Debye Huckel Onsager equation.

iv) Determine the equivalent conductance of a weak electrolyte i.e. CH_3COOH at infinite dilutionby Kohlrasch law.

v) Determine the degree of hydrolysis and hydrolysis constant of CH_3COONa, NH_4Cl.

pH metry

i) Determine the strength of unknown solution of HCl by titrating it with NaOH solution using pH meter.

ii) To find the strength of unknown solution of NH_3 solution by titrating it with CH_3COOH solution.

iii) To find the strength of unknown solution of Na_2CO_3 solution by titrating it with HCl solution.

iv) To find out the dissociation constant of polybasic acid e.g. phosphoric acid by titrating it with NaOH solution.

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **PSCHPC307** Course Category: **PSCC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **03** Maximum Marks: **75**
No. of hours**: 45**

Syllabus for the examinations to be held in Dec 2015, Dec 2016 & Dec 2017.

ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR and MS).

BOOKS RECOMMENDED

1. Vogel's text book of Quantitative analysis, revised, J. Bassett, R.C. Denney, G.H. Jaffery and J. Mendham, ELBS.
2. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miler, Prentice Hall.
3. Synstematic Qualitative Organic analysis, H. Middlenton, Adward Arnold.
4. Experimental Organic Chemistry, Principles and Practice, Lawrence M. Harwood and Christopher J. Moody, Blackwell Scientific Publications.
5. Spectrometric Identific of Organic compounds, R.M. Silverstein, G.C. Bassler and T.C. Marrill, John Wiley.
6. Spectroscopic methods in Organic chemistry, D.H. Williams, I. Fleming, Tata McGraw Hill.
7. Organic Spectroscopic, William Kemp.

DETAILED SYLLABUS

Course No.: **PSCHTE401** Course Category: **PSEC**
Title: **Analytical Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Separation Methods

Solvent Extraction

Liquid-liquid extraction, Principles and process of solvent extraction, Techniques of solvent extraction, Extraction by chelation, Extraction by salvation, Extraction equilibria for chelation and salvation, Extraction by ion pair formation.

Classification of chromatographic methods, Column chromatography, Adsorption phenomenon, nature of adsorbents, solvent systems, differential migration, Thin-layer chromatography (TLC), coating materials and preparation of TLC plates, solvents for development, detection of compounds in TLC, R_f value in TLC, applications of TLC in chemistry.

Ion-exchange chromatography, Principle and theory of cation-exchange and anion-exchange chromatography, Applications of ion-exchange chromatography, ion chromatography as separation technique, structure and characteristics of resins, eluants used in separation, detectors used in ion chromatography, analytical application of ion chromatography

Paper chromatography, Nature of paper-support, stationary phase, solvent system, technique of paper chromatography, various modes of development: ascending, descending and horizontal, applications.

Thermoanalytical and Electroanalytical Methods

Introduction, Thermogravimetry (TG), instrumentation, Differential thermal analysis (DTA) and differential scanning calorimetry (DSC), applications of thermal methods.

Potentiometric method: Reference electrodes and indicator electrodes. The hydrogen, calomel and Ag-AgCl electrodes, The glass electrode, performance and limitations, measurement of pH, potentiometric titrations, redox and precipitation titrations.

Application of Electrochemistry: Electrode reaction fundamentals, potentials of electrochemical reactions, Electrochemical cells and practical considerations, solvent/electrolyte for electrochemistry, working, reference and auxiliary electrodes, Applications: Potential sweep methods, linear sweep voltametry (LSV), cyclic voltametry (CV), Practical considerations for potential sweep methods, Example of application of CV to study Rh complexes, surface- attached analytes in CV

Fuel analysis : Classification of fuels, grading of coal, proximate and ultimate analysis of coal, producer, water and natural gas, calorific value of fuel, Flash and fire point of liquid fuels, aniline point of liquid fuels, carbon residue of liquid fuels, octane and cetane numbers

Clinical Chemistry and Drug Analysis

Clinical Chemistry : Composition of blood-collection and preservation of samples, clinical analysis, serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin,

globulins, barbiturates, acid and alkaline phosphates. Immunoassay : principles of radio immunoassay (RIA) and applications, blood gas analysis.
Drug analysis : Narcotics and dangerous drug, Classification of drugs, screening by gas chromatography and thin-layer chromatography and spectrophotometric measurements.

BOOKS RECOMMENDED

1. A Textbook of Quantitative Inorganic Analysis, A. I. Vogal, Longman
2. Analytical Chemistry, G. D. Christian, J. Wicy.
3. Fundamentals of analytical Chemistry, D. A. Skoog. D. M. West and F. J. Hooler, W. B. Saunders.
4. Analytical Chemistry-Principles. J. H. Kennedy and W. B. Saunders
5. Analytical Chemistry-Principles.and Techniques. L. G. Hargis, Prentice Hall.
6. Analytical Chemistry, 2nd Edn., Kellner, Mermet, Otto, Valcarcel, Widmer. Wiley-VCH
7. Applications of physical methods to Inorganic and Bioinorganic Chemistry, Robert A. Scott, Charles M. Lukehart, Wiley.
8. Principles and practice of Analytical Chemistry, 5th Edn., Fifield & Kealey, Bleckwell Science.
9. Basic concepts of Analytical Chemistry, 2nd Edn., S. M. Khopkar, New Age Intl. Ltd. Publishers.
10. Analytical Chemistry, H. Kaur, Pragati Prakashan.
11. Analytical Chemistry, Dr. Alka Gupta, Pragati Prakashan.
12. Analytical Chemistry, Krupadanam et al, Universities Press.
13. Analytical Chemistry, Kealey and Haines, Instant Notes, Viva.

DETAILED SYLLABUS

Course No.: **PSCHTE402** Course Category: **PSEC**
Title: **Organotransition Metal Chemisty**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**
Syllabus for the examinations to be held in May 2016, May 2017 & May 2018

Compounds of Transition Metal-Carbon Multiple Bonds
Alkylidenes, alkylidynes: low valent (Fischer) and high valent (Schrock) carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions of the ligands and applications.

Transition Metal – π Complexes
Transition Metal – π complexes with unsaturated organic molecules like alkenes, alkynes, allyls, diene and arene complexes, preparation, properties, chemical reactions, nature of bonding and structural properties.

σ – Bonded Transition Metal Complexes (Hydrocarbyls)
Types, bonding and structure of hydrocarbyls, routes of synthesis, thermal stability and decomposition pathways, chemical reactions and applications of organo-copper compounds in organic synthesis.

Homogeneous Catalysis
Stoichiometric reactions for catalysis, activation of C-H bond, homogeneous catalysis hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxopalladation reactions.

Fluxional Organometallic Compounds
Fluxionality and dynamic equilibria in compounds such as η^2-olefin, η^3-allyl and dienyl complexes, non-rigid molecules in different coordination geometry.

Transition Metal Compounds with Bonds to Hydrogen
Chemistry of transition metal compounds with bonds to hydrogen: Types, synthesis and chemical reactions; Aluminohydrides and Borohydrides.

BOOKS RECOMMENDED

1. Principles and Applications of Organotransitiion Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
5. Basic Organometallic Chemistry, Concepts, Syntheses and Applications, B.D. Gupta and A.J. Elias, University Press.

DETAILED SYLLABUS

Course No.: **PSCHTE403** Course Category: **PSEC**
Title: **Bioinorganic and Supramolecular Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Bioenergetics and ATP Cycle
DNA polymerization, glucose storage, metal complexes in transmission of energy, chlorophyll's, photosystem I and photosystem II in cleavage of water.

Transport and storage of dooxygen
Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Nitrogen fixation
Biological nitrogen fixation and its mechanism, nitrogenase, chemical nitrogen fixation.

Electron transfer in biology
Structure and function of metalloproteins in electron transport processes – Cytochromes and Iron-Sulphur proteins, synthetic models.

Metal Storage, Transport and Biomineralization
Ferritin, transferrin and siderophores.

Zinc enzymes – carboxypeptidase and carbonic anhydrase
Iron enzymes – catalase, peroxidase and cytochrome P-450
Copper enzymes – superoxide dismutase
Molybdenum oxotransferase enzymes – Xanthine oxidase, coenzyme Vitamin B_{12}.

Supramolecular Chemistry

Molecular recognition
Introduction to recognition, information and complementarity, Molecular receptors- design Principles, Spherical recognition- cryptates of metal cations, Tetrahedral recognition by Macrocyclic cryptands, Recognition of ammonium ions and related substrates, Recognition of neutral molecules, Recognition of anionic substrates (anionic coordination).

Transport processes and carrier design
Carrier – mediated transport, Cation transport processes – Cation Carriers, Anion transport Processes – anion carriers, Coupled processes.

Molecular and Supramolecular devices, supramolecular photochemistry, supramolecular electronic devices, supramolecular ionic devices

Metals in medicine
Metal deficiencies and diseases, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

BOOKS RECOMMENDED

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.

3. Inorganic Biochemistry Vols. I and II ed., G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols. 18 and 38 ed., J.J. Lippard, Willey.
5. Supramolecular Chemistry, J. M. Lehn, VCH.

DETAILED SYLLABUS

Course No.: **PSCHTE404** Course Category: **PSEC**
Title: **Solid State Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018

General Principles of Solid State Reactions

Solid state reactions and Crystal defects - Perfect and imperfect crystals, Intrinsic and extrinsic defects, Point defects (Schottky and Frenkel defects), Thermodynamics of Schottky and Frenkel defect formation, Colour centres, Line defects: Edge dislocation and Screw dislocation, Plane defects: Grain boundary and Staking faults, Non-stoichiometry and defects. Topochemical control of solid state organic reactions, New superconductors

Solid solutions: Substitutional solid solutions, interstitial solid solutions, more complex solid solutions mechanisms, requirements for solid solutions and formation.

Preparative Methods and Crystal Symmetry

Preparation of materials in solid state: Precursor, ceramic, sol-gel, hydrothermal, electrochemical reduction methods, vapour phase transport and high pressure methods, preparation of thin films, growth of single crystals, Closed packed structures: cubic close packing and hexagonal close packing, Some important structure types : NaCl, ZnS, CsCl and perovskite ($SrTiO_3$).

Structure of Solids

Crystal systems, Bravais lattice, lattice planes, Miller indices and directions, symmetry: point symmetry, space symmetry and point groups. Representation of point groups and selected examples (orthorhombic point groups: *222*, *mm2*, *mmm*), space groups.

Electronic and Ionic Conduction

Metals, insulators and semiconductors, electronic structure of solids ; chemical and physical approaches- band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping of semiconductors, P N junction, Band structure in organic solids, colour in organic solids, Ionic conductivity in solids, Solid electrolytes- Fast ion conductors (α-AgI, β-Alumina, Stabilized zirconia).

Magnetic Properties

Magnetic properties – classification of materials. Behaviour of substances in a magnetic field, effect of temperature : Curie and Curie-Weiss laws, calculation of magnetic moments, Mechanisms of ferro and anti-ferromagnetic ordering, super exchange and double exchange, Theory of diamagnetism, Langevin's theory of paramagnetism, quantum mechanical approach for paramagnetism, Theory of ferromagnetism, antiferro and ferri magnetism, Ferromagnetic domains and hysteresis, soft and hard magnetic materials.

BOOKS RECOMMENDED

1. New Directions in Solid State Chemistry: C.N.R. Rao and J. Gopalakrishan, Cambridge University press, Cambridge.
2. Solid State Chemistry, A.R. West, John Wiley, New York.
3. Solid State Physics, N.J. Dekker, Macmillan, London.
3. Solid State reactions, H. Schmalaried, A.P., London.
4. Magnetochemistry, R.L. Catin, Springerverlag, Berlin.
5. Solid State Chemistry, N.B. Hannay, Prentice Hall (India) Ltd., New Delhi.
6. Solid State Chemistry, H.V. Keer.

DETAILED SYLLABUS

Course No.: **PSCHTE405** Course Category: **PSEC**
Title: **Polymer Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Introduction
Importance of polymers, Basic concepts: Monomers, repeat units, degree of polymerization. Linear branched and network polymers, classification of polymers. Polymerization: Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in mohomegeous and heterogeneous systems.

Polymer Characterization
Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, ismotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

Structure and Properties
Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Crystallization and melting. Polymer structure and physical properties-crystalline melting point, T_m-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g, effect of molecular weight, diluents, chemical structure, chain topology, branching and cross lonking.

Polymer Processing
Property requirements and polymer utilization, Plastics, elastomers and fibres. Processing techniques: Compounding, Calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Properties of Commercial Polymers
Polyethylene, polyvinyl chloride, polyamides, polysters, phenolic resins, epoxy resins and silicon polymers. Functional polymers-Fire retarding polymers and electrically conducting polymers, biomedical polymers-contact lens, dental polymers artificial heart, kidney, skin and blood cells.

BOOKS RECOMMENDED

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.R. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.

DETAILED SYLLABUS

Course No.: **PSCHTE406** Course Category: **PSEC**
Title: **Chemistry of Materials**
Credits: **04**
No.of hours**: 60** Maximum Marks: **100**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Multipurpose Materials
Ferrous alloys; Fe-C phase transformations in ferrous alloys, stainless steels; non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

Glasses, ceramics and Composites
Glassy state, glass formers and glass modifiers, applications Ceramic structures, mechanical properties.
Microscopic composites; dispersion-strengthened and particle-reinforced fibre-reinforced composites, macroscopic composites.

Thin Films and Langmuir-Blodgett Films
Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

Liquid Crystals
Mesomorphic behavior, classification of liquid crystals, nematic and smectic mesophases; homeotropic, planer, schlieren textures, Nematic droplets, Mauguin textures, Texturesin smectic phases, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric properties.

Polymeric Materials
Molecular shape, structure and configuration, crystallinity stress-strain behavior, thermal behavior, polymer types and their applications, conducting and ferro-electric polymers.

Ionic Conductors
Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.

High T_C Materials
Defect perovskites, high T_C superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high T_C materials, applications of high T_C materials.

Materials for Solid State Devices
Rectifiers, transistors, capacitors – IV-V compounds, low-dimensional quantum structures, optical properties.

Organic Solids, Fullerences, Molecular Devices
Conducting organics, organic superconductors, magnetism in organic materials.
Fullerences-doped, fullerences as superconductors.
Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches sensors.

Nonlinear optical materials: nonlinear optical effects, second and third order – molecular hyperpolarisability and second order electric susceptibility – materials for second and third harmonic generation.

BOOKS RECOMMENDED

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders Collage.
2. Materials Science and engineering, An Introduction, W.D. Callister, Wiley.
3. Principles of the Solid state, H.V. Keer, Wiley Eastern.
4. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
5. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.

DETAILED SYLLABUS

Course No.: **PSCHTE407** Course Category: **PSEC**
Title: **Heterocyclic Chemistry and Asymmetic Synthesis**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Nomenclature of Heterocycles
Replacement and systematic nomenclature (Hantzsch-Widmann system) for monocyclic, fused and bridged heterocycles and simple spiroheterocycles. Carbocycles, ring assemblies, same repeating units, different repeating units.

Aromatic Heterocycles
General chemical behavior of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra, empirical resonance energy, delocalization energy and diamagnetic susceptibility), Alprazolam, Aphox.

Benzo-Fused Five Membered Heterocycles
Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.

Six-Membered Heterocycles with One heteroatom
Synthesis and reactions of pyridinium salts and pyridines.
Synthesis and reactions of benzopyrylium salts, coumarins and chromones.

Six Membered Heterocycles with two or more Heteroatoms
Synthesis and reactions of diazines and triazines (Pyrazines, Pyridazines and 1,2,4-triazines).

Seven- and Large-Membered Heterocycles
Synthesis and reactions of azepines, oxepines and thiepines.

Asymmetric synthesis: Non-enzymatic approaches
Models of asymmetric synthesis using naturally occurring chiral compounds. Nucleophile and electrophile bearing chiral auxillary, Diels–Alder cycloaddition and Claisen–cope rearrangements.
Asymmetric carbon – carbon bond formation using alkylation, Michael reaction and addition to carbonyl compounds. Cram's rule and Felkin–Ahn model. Asymmetric oxidation and reduction.

Asymmetric Synthesis: Enzymatic approach
Use of different types of enzymes- lipases (PLAP), oxidases, reductases, Bayer-Villiger monooxygenase, penicillin acylase and Baker yeast in organic synthesis. Enzyme-triggered cyclization of haloalkyl oxiranes catalyzed by epoxide hydrolases. application to biomimetic natural product ((3*R*,9*R*,10*R*)-panaxytriol, (+)-pestalotin and (2*R*,5*S*)-pityol) synthesis.

BOOKS RECOMMENDED

1. Heterocyclic Chemistry, Thomas L. Gilchrist, 3rd Edition, Addison Wesley Longman Limited 1997.
2. Heterocyclic Chemistry, Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
3. The Chemistry of Heterocycles, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.

4. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Pandler, Wiley Interscience.
5. An Introduction to Heterocyclic Compounds, R.M. Acheson, John Wiley and Sons.
6. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, Eds. Pergamon Press.
7. G.Solladie, J.D. Morrison (ed.), Asymmetric Synthesis, Academic Press.
8. Advanced Asymmetric Synthesis, ed. G.R. Stephenson, Blackie, Glasgow, 1996.
9. Organic Synthesis, Michael B. Smith, McGraw Hill, International Edition.

DETAILED SYLLABUS

Course No.: **PSCHTE408** Course Category: **PSEC**
Title: **Organic Synthesis**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Disconnection Approach
An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections (1,2 and 1,3-difunctionalised compounds), chemoselectivity, reversal of polarity.

One Group C-C Disconnections
Alcohols and carbonyl compounds, regioselectivity, use of acetylenes and aliphatic nitro compounds in organic cynthesis.

Two Group C-C Disconnections
Biological Cope, Cope and Claisen reaction, Diels-Alder reaction, 1,3-difunctionalised compounds, α, β-unsaturated carbonyl compounds, 1,5-difunctionalised compounds, Michael addition and Robinson annelation.

Protecting Groups
Principle of protection of alcohol (Acetal, Acetyl and silyl ethers) and carbonyl groups.

Retrosynthesis and synthesis of following compounds:
Reserpine (Woodward synthesis), Longifolene (Corey synthesis), α-Bourbonene (Brown synthesis).

Organometallic Compounds of Transition Elements
Hydrogenation, hydrosilylation and hydrogen-transfer isomerization catalyzed by Ni, Pd and Rh complexes; Coupling reactions (C-C, C-N and C-O bond formation) catalyzed by Pd, Ni and Cu complexes; Carbonylation (Hydroxymethylation, hydroformylation and hydrocarboxylation of alkenes) catalyzed by Fe, Co, Pd and Ni compounds.

Oxidations
Oxidation of alcohols (Chromic acid, $KMnO_4$, $Pb(OAc)_4$, Oppenauer Swern); aldehydes and ketones (chromium trioxide complexes); Amine (H_2O_2, peracids and quinones); sulfides (peracid, HIO_4). Oxidation of alcohols by O_2 catalysed by Pd and Co.
Oxidation with osmium and ruthenium tetraoxide, iodobenzene diacetate and thalium (III) nitrate.

Reduction
Birch reduction; Reduction of aldehydes, ketones, acids and their derivatives (Clemenson, Wolff Kishner, lithium aliminium hydride, sodium borohydride, DIBAL-H, diborane, aluminium isopropoxide).
Reduction of nitro, azo, oxime and nitrile groups (Lithium aliminium hydride and DIBAL-H).

BOOKS RECOMMENDED

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis – Concept, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlage VCH.
3. Some Modern Methods of Organic Synthesis, W. Carruther, Cambridge University Press.
4. Principles of Organic Synthesis, R. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Chemistry of Natural Products, S.V. Bhat, B.A. Nagasampagi and M. Sivakumar, Narosa Publ. House, N.D.
6. Progress in Total Synthesis Vol. 1, E. Danishetsky and S. Danishetsky, Appleton Centyrt Crafts, N.Y.
7. Organic Synthesis, J. Fuhrhop and G. Penzlin, (1986). VCH, Verlags, Weinheim, Germ.
8. The Total Synthesis of Natural Products Vol. 4, J. Apsimon (1981), John Wiley Interscience Publ. (N.Y.).
9. The Logic of Chemical Synthesis, E.J. Corey and X.M. Cheng, John Wiley and Sons, New York, N.Y.
10. Organic Chemistry, Maitland Jones Jr., W.W. Norton and Co. Inc.
11. Organometallic Chemistry: A unified approach, New Age International Publishers.
12. Applications of Transition Metal Catalysis in Organic Synthesis, Brandsna, Vasilvsky, Verkruijsse, Springer, Berlin.

DETAILED SYLLABUS

Course No.: **PSCHTE409** Course Category: **PSEC**
Title: **Chemistry of Natural Products and Molecular Rearrangements**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Terpenoids and Carotenoids
Classification, occurrence and isoprene rule. Structure determination, stereochemistry and synthesis of the following representative molecules:
α–Terpineol, Menthol, Farnesol, Santonin, β–Carotene and squalene.

Alkaloids
Definition, physiological action, occurrence and isolation. Structure elucidation and synthesis of Quinine, Morphine and Colchicine.

Steroids
Occurrence, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Testosterone, Estrone, Progestrone.

Plant Pigments
Occurrence, and general methods of structure determination of anthocyanins, flavones & isoflavones. Synthesis of Apigenin, Quercetin, Cyanidin and Cyanin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Rearrangements
General mechanistic considerations – nature of migration, migratory aptitude, memory effects.
A detailed study of the following rearrangements:
Tiffeneau- Demjanov, Benzil-Benzilic acid, Favorskii, Stevens, Arndt-Eistert synthesis, Neber, Hofman, Curtius, Schmidt, Baeyer-Villiger and Shapiro, Eschenmosher and Prins reaction.

BOOKS RECOMMENDED

1. Natural Products: Chemistry and Biological Significance, J.Mann, R.S. Davidson, J.B.Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol.2, I.L. Finar, ELBS.
3. Stereoselective Synthesis: A practical Approach, M.Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A.Marston, Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Harwood Acade–mic Publishers.
7. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
9. Polar rearrangements, Laurence M. Harwood, Oxford Science Publications, Oxford University Press.
10. Organic Synthesis, Michael B. Smith, McGraw Hill.

DETAILED SYLLABUS

Course No.: **PSCHTO410** Course Category: **PSOCC**
Title: **Instrumentation and Analytical Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**
Syllabus for the examinations to be held in Dec. 2015, Dec. 2016 & Dec. 2017.

Separation Methods: Chromatography-I
Introduction, Classification of Chromatographic methods,
Column Chromatography: Adsorption phenomenon: nature of adsorbents, solvent systems, differential migration,
Thin-Layer Chromatography (TLC): coating materials and preparation of TLC plates, solvents for development, Detection of compounds in TLC, R_f values in TLC
Ion-Exchange Chromatography: Theory and apparatus, Cation exchange resins, anionexchange resins, Applications of ion-exchange chromatography

Separation Methods: Chromatography-I I
Paper Chromatography: Nature of paper- support, stationary phase, application of sample, solvent system-mobile phase, theoretical principles of paper chromatography, detection of spots, R_f values in paper chromatography, Various methods of development- ascending, descending and horizontal, applications
High-Performance Liquid Chromatography (HPLC): HPLC instrument, stationary phase in HPLC, normal phase and reversed phase HPLC- a comparison, Retention times in HPLC, applications of HPLC.

Instrumentation Methods in Analysis
UV-Visible Spectroscopy: Origin of spectra and electronic transitions, Quantitative aspects of UV-Visible absorption measurement, Lambert's Law, Beer's Law, Beer-Lambert's Law, Calibration graph for quantitative analysis, General design of instruments for absorbance measurements, visible photometer or colourimeter, single-beam and double-beam spectrophotometer.
Atomic Absorption Spectroscopy: Principles of atomic absorption spectroscopy, Instrumentation for AAS, Applications of atomic absorption spectroscopy, sensitivity, detection limit and spectral interferences in atomic absorption spectroscopy.
Atomic Emission Spectroscopy and Flame Photometry
Principles of emission spectroscopy, source of excitation, instrumentation for AES, Flame emission spectroscopy, qualitative and quantitative analysis, limitations of Flame emission spectroscopy, principles of plasma emission spectroscopy, Inductively coupled plasma source, ICP-AES instrumentation, applications, comparison of ICP-AES with AAS.

Instrumentation Methods in Analysis-II
Atomic Emission Spectroscopy and Flame Photometry
Principles of emission spectroscopy, source of excitation, instrumentation for AES, Flame emission spectroscopy, qualitative and quantitative analysis, limitations of Flame emission spectroscopy, principles of plasma emission spectroscopy, Inductively coupled plasma source, ICP-AES instrumentation, applications, comparison of ICP-AES with AAS.
Thermal methods of analysis
Thermal gravimetric analysis, Factors affecting TGA, applications; Principles of DTA and DSC, Factors affecting DTA and DSC, applications

Diffraction Analysis and Polarography

Miller Indices, Crystal lattice, Unit cells and crystal systems, Symmetry in crystals, Diffraction of X-rays, Diffraction techniques, Debye-Scherrer method, Indexing and Determination of lattice parameters of a unit cell, Determination of Bravais lattices, Crystal structure of sodium chloride and Potassium chloride

Principle of polarography, instrumentation, half wave potential, Illkovic equation, equation of wave.

BOOKS RECOMMENDED

1. Basic Concepts of Analytical Chemistry, S. M. Khopkar, New Age International Publishers, 2nd Edition, 2005.
2. Analytical Chemistry, G. L. David Krupadanam, D Vijaya Prasad, K. Varaprasad Rao, K. L. N. Reddy, C. Sudhakar, University Press(india) Limited, 2001.
3. Analytical Chemistry, H. Kaur, Pragati Prakashan, 2008.

DETAILED SYLLABUS

Course No.: **PSCHLE411** Course Category: **PSEC**
Title: **Laboratory Course: Inorganic Chemistry**
Credits: **08** Maximum Marks: **200**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

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270 hrs

Preparation of selective inorganic compounds and their study by IR, electronic spectra, and magnetic susceptibility measurement. Handling of air and moisture sensitive compounds involving vacuum lines.

Selection can be made from the following:

1. Preparation of tetraamminecarbonatocobalt(III) nitrate and its conversion to pentaamminecholorocobalt(III) chloride; Inorganic Syntheses; Wiley-Interscience: pp 103 (1983).
2. Preparation of trans-dicholoro bis(ethylenediamine)cobalt(III) chloride and its conversion to cis-isomer; Inorg. Synth. 14, 63 (1973,).
3. Preparation of tris(ethylenediamine)nickel(II) chloride and its conversion to bis(ethylenediamine)nickel(II) chloride; Inorg. Synth. 6, 200, (1960); Inorg. Synth. 6, 198, (1960).
4. Preparation of pentaamminecholorocobalt(III) chloride and study of Linkage isomers by its conversion to pentaammminenitritocobalt(III) chloride and to nitro isomer followed by IR characterization; Inorganic Chemistry 18, 1869 (1979).
5. Preparation and mangnetic moment of $Cu(acac)_2H_2O$; Inorg. Synth. 20: 53 (1980).
6. Separation of optical isomer cis-$[Co(en)_2Cl_2]Cl$. J. Chem. Soc., 1960, 4369.
7. Ion exchange separation of oxidation state of vanadium. J. Chem. Educ., 1980, 57, 316; 1978, 55, 55.
8. Preparation of Fe(II)chloride (use it as Friedelcraft chlorination source). J. Org. Chem., 1978, 43, 2423, J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
9. Preparation and use of Ferrocene, J. Chem. Edu., 1966, 43, 73; 1976, 53, 730.
10. Preparation of phosphine Ph_3P and its transition metal complexes. Inorg. Synth. 15, 45 (1974).
11. Reaction of Cr(III) with a multidentate ligand: a kinetic experiment (visible spectra Cr-EDTA complex) J.A. C. S., 1953, 75, 5670.
12. Preparation of metal-pyridine complexes, $M(C_5H_5N)_y(NCS)_2$, (M = Mn, Fe, Co or Ni; y = 4, for M= Cu or Zn; y = 2), J. Chem. Edu, 50, 70 (1973).
13. Preparation of Chromium(III) complexes, $[Cr(H_2O)_6]NO_3.3H_2O.[Cr(H_2O)]_4Cl_2]Cl.2H_2O$, $[Cr(en)_3]Cl_3.Cr(acac)_3$, Inorg. Synth.,13, 184 (1972).

Gravimatric and Volumetric analysis: Barium, Copper, Cobalt, Iron, Vanadium, Nickel, Manganese, Aluminium, Chromium, Zinc, Sulfur, Chloride (Volhard's method) etc.

Separation by Paper/TLC/Column Chromatography and Estimations:

1. Separation of Permanganate and Bichromate ions on Alumina column and their Estimation from Beer Law plots.
2. Determination of lonisable chloride in a Complex by cation exchange column (separation followed by Mohr's titration of elute for estimation).
3. Separation of Cobalt(II) and Nickel(II) on anion exchange column followed by estimation through EDTA titrations.

4. Separation of two Cobalt (III) complexes *viz* $[Co(NH_3)_6]Cl_3$ and $[Co(NH_3)_5Cl]Cl_2$ on Silica column.
5. Ion exchange separation of Hydration/ionization isomers of Chromium(III) Chloride ($CrCl_3$).
6. Determination of Rf value of cations of transition metal ions by paper and thin layer chromatography

Books Recommended:

1. Vogel's textbook of quantitative chemical analysis (5^{th} and 6^{th} edition).
2. G. R. Chatwal, Instrumental Methods for Chemical Analysis, 5^{th} ed., Himalaya Publications (India)

DETAILED SYLLABUS

Course No.: **PSCHLE412** Course Category: **PSEC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **08** Maximum Marks: **200**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

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270 hrs

1. Determination of Planck's Constant by means of LED's method based on expression of diode current for $V<V_0$. The dependence of current with temperature is to be measured, keeping the V slightly below V_0 and material constant η to be obtained from V-I characteristics of the diode.
2. Four Probe set-up for measuring the resistivity of very low to highly resistive samples at temperature upto 200°C with PID controlled oven, having the following setup:
   (i) Four Probe Arrangement with built-in RTD sensor & PID controlled Oven
   (ii) D.C. Microvoltmeter
   (iii) Constant Current Source
   For low resistivity samples like thin films for metals and alloys
   (iv) Low Current Source
3. Measurement of Magentoresistance of Semiconductors with the apparatus consisting of:
   a) Four Probe Arrangement
   b) Sample: Ge Crystal (n-type)
   c) Magnetoresistance setup
   d) Electromagnet
   e) Constant Current Power Supply
   f) Digital Gaussmeter
4. Study of Dependence of Hall Coefficient on Temperature by the following setup:
   a) Hall Effect Setup
   b) Hall Probe (Ge: p-type) with a small oven
   c) Electromagnet
   d) Constant Current Power Supply
   e) Digital Gaussmeter
5. Study of the energy band-gap and diffusion potential of P-N Junctions.
6. Study of T_C and other related properties in high T_C superconductors.
7. Determine the order, the velocity constant and the activation energy of the hydrolysis of tertiary-amyl iodide.
8. Determine the velocity constant of the decomposition of benzene diazonium chloride.
9. Determine the velocity coefficient of inversion of sucrose by 0.5N hydrochloric acid at 25°C.
10. To determine the basicity of an organic acid by conductometric measurement.
11. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
    a) Determine the rate constant and order of the reaction.
    b) Study the influence of ionic strength on the rate constant.
12. Determine the dissociation constant of picric acid by studying its distribution between benzene and water.
13. Investigate the reaction between acetone and iodine, potassium permanganate and oxalic acid.
14. Precipitation titrations using conductivity meter.

15. Determine acid and base dissociation constant of amino acid and find isoelectric point of acid (glycine).

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **PSCHLE413** Course Category: **PSEC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **08** Maximum Marks: **200**
No.of hours**: 120**

Syllabus for the examinations to be held in May 2016, May 2017 & May 2018.

Multi-Step Synthesis of Organic Compounds

The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.

Photochemical reaction: Benzophenone→Benzpinacol→Benzpinacolone

Beckmann rearrangement: Benzanilide from benzene

Benzophenone→Benzophenone oxime→Benzanilide

Benzilic acid rearrangement: Benzilic acid from benzoin

Benzoin→Benzil→Benzilic acid

Synthesis of heterocyclic compounds-Three component coupling for the synthesis of dihydropyrimidinones.

Scraup Synthesis: Preparation of quinoline from aniline

Fisher – Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine

Synthesis using microwaves

Alkylation of diethyl malonate with benzyl chloride

Synthesis using phase transfer catalyst

Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide

Extraction of Organic Compounds from Natural Sources

16. Isolation of caffeine from tea leaves
17. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
18. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported)
19. Isolation of piperine from black pepper
20. Isolation of lycopene from tomatoes

Spectrophotometric (UV/VIS) estimations of any four of the following:

1. Amino acids
2. Proteins
3. Carbohydrates
4. Cholesterol
5. Ascorbic acid
6. Aspirin
7. Caffeine

BOOKS RECOMMENDED

1. Elementary Practical Organic Chemistry, Part-1, 2nd ed., Vogel.
2. Monograph on Green Chemistry by Green Chemistry Task Force Committee, DST.
3. Spectrophotometric determination of amino acid by Michail A. Alterman, Peter Hunziker, Vol. 828, Print ISBN: 978-1-61779-444-5.